NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

June 4, 2009

Group Chairman's Factual Report

OPERATIONAL FACTORS / HUMAN PERFORMANCE

DCA08MA098

A. ACCIDENT

Operator:	Global Exec Aviation
Location:	Columbia Metropolitan Airport, South Carolina
Date:	September 19, 2008
Time:	2353 eastern daylight time[1]
Airplane:	Learjet LR-60, Registration Number: N999LJ, Serial # 314

B. OPERATIONAL FACTORS / HUMAN PERFORMANCE GROUP

Captain B. David Tew - Chairman Operational Factors Division (AS-30) National Transportation Safety Board 490 L'Enfant Plaza East, SW Washington, DC 20594-2000	Dr. Evan Byrne – Member Human Performance Division (AS-60) National Transportation Safety Board 490 L'Enfant Plaza East, SW Washington, DC 20594-2000
Captain David L. Helson - Member Operational Factors Division (AS-30) National Transportation Safety Board 490 L'Enfant Plaza East, SW Washington, DC 20594-2000	Dr. Katherine Wilson – Member Human Performance Division (AS-60) National Transportation Safety Board 490 L'Enfant Plaza East, SW Washington, DC 20594-2000
Captain Charles (Chaz) Perrigoue Director of Operations Global Exec Aviation 3250 Airflite Way Long Beach, CA 90807	Captain Ed Grabman Engineering Test Pilot Bombardier – Learjet P.O. Box 7707, MS 84 Wichita, KS 67277-7707

[1] All times are eastern daylight time (edt) based on a 24-hour clock, unless otherwise noted. Actual time of accident is approximate, determined by the Air Traffic Control (ATC) transcripts.

C. SUMMARY

On September 19, 2008, about 2353 Eastern Daylight Time (EDT), N999LJ, a Learjet LR-60 operated by Global Exec Aviation, crashed during takeoff from Columbia Metropolitan Airport (CAE), Columbia, South Carolina. The airplane, which had been cleared for back taxi and takeoff on runway 11, ran off the end of runway 11 on the takeoff roll. Of the 4 passengers and 2 crewmembers on board, 4 were killed and 2 received serious injuries. The airplane was destroyed by impact forces and post-crash fire. The flight was operated under 14 *Code of Federal Regulations* Part 135 and was en route to Van Nuys Airport (VNY), Van Nuys, California.

D. DETAILS OF THE INVESTIGATION

The NTSB investigators on the Operations Group traveled to CAE on Saturday, September 20, 2008 where they inspected the accident site, photographed the debris field, and gathered flight documents from the wreckage. The group gathered duplicates of fuel receipts and available flight planning documents that were used by the accident crew.

On September 20 and 21, 2008, the group conducted interviews[2] with eyewitnesses of the accident flight, collected copies of flight crew records from the company, auditioned Air Traffic Control tower tapes, and conducted a preliminary review of the accident airplane weight and balance.

The group conducted the field phase of the investigation from the NTSB command post at CAE, from September 21 to September 25. Company records were reviewed, including training and personnel records of the accident crew. The group reviewed company and manufacturer manuals, and gathered information for the 72-hour history of the accident crew.

Interviews were conducted with the Global Exec Aviation Director of Operations, who was also a Learjet 60 captain and check pilot, a Bombardier Learjet Engineering Test Pilot, the fueler who fueled the accident airplane and witnessed the accident, and two Federal Aviation Administration Air Traffic Controllers who witnessed the accident while on duty in the CAE Air Traffic Control (ATC) tower.

In addition, the group conducted interviews via telephone from the NTSB command post with the current and previous Federal Aviation Administration (FAA) Principal Operations Inspectors (POI) for Global Exec Aviation, an FAA inspector who administered a line check to the accident captain in May 2008, and two Flight Safety International instructor / examiners who had given ground and simulator training and checkrides to the accident pilots.

After completion of the field phase of the investigation, the group conducted numerous interviews via telephone from NTSB headquarters. The investigation included follow up

[2] See attachment 1 – Interview Summaries

interviews with some interviewees from the field investigation as well as interviews with flight crew members who had flown with the accident crew, family members of the accident crew, former employers of the accident crew, Chief Pilots and a Director of Operations for other Learjet 60 operators, flight simulator instructors and technicians, and FAA personnel having oversight of the facilities that provided training to the accident crew and company.

In addition to interviews, the group researched extensively the history of uncommanded / inadvertent thrust reverser stowage on Learjet 60 airplanes; the previous occurrences, manufacturer and industry awareness and guidance, and flight crew training.

1.0 HISTORY OF FLIGHT

On September 18, 2008, the accident crew conducted a test flight[3] in the accident airplane. The flight departed from Teterboro Airport (TEB), Teterboro, New Jersey, at about 1200 and returned to TEB. The duration of the flight was 48 minutes and the results were satisfactory.

On September 19, 2008, at about 2142, the accident crew and airplane departed TEB on a flight to reposition the airplane to Columbia Metropolitan Airport (CAE), Columbia, South Carolina, for a passenger flight to Van Nuys, California.

The accident crew and airplane arrived at CAE at about 2310. Upon arrival, the accident captain exited the airplane and prepared the airplane fuel control panel for fueling.

The passengers arrived via ground transportation and the captain assisted with loading of baggage on the airplane. After fueling was completed, the accident first officer secured the fuel control panel and proceeded into the fixed base operator (FBO) building with the fueler to pay for the fuel.

According to company records, the captain notified Global Exec Aviation via telephone at 2339 that they were about to start engines for departure. The engines were started and the first officer called air traffic control for a taxi clearance at 2346. After receiving a wind report from ATC, the crew requested runway 11 for takeoff. Due to construction and taxiway closures, ATC issued a taxi clearance to runway 11 that required a right turn out of the ramp and across the north end of the closed runway (runway 5/23).

At about 2349, the crew made a left turn out of the ramp towards runway 11/29. ATC observed the incorrect turn and offered the crew the option to back-taxi down runway 29 if they would be ready for an immediate departure. At 2350, the crew advised ATC they would be ready for departure and ATC issued a clearance to back taxi down runway 29 to the start of runway 11, and cleared them for takeoff on runway 11.

[3] Test flight – On September 12, 2008, on a scheduled flight departing from Teterboro Airport (TEB), Teterboro, New Jersey, the accident airplane had a dual bleed air overheat when a high pressure bleed valve stuck in the open position. The flight returned to TEB for repairs. On September 18, 2008, the accident crew conducted a test flight to verify that repairs to the high pressure bleed valve were effective.

The crew taxied the airplane out of the ramp, back taxied down the runway and upon reaching the start of runway 11 the crew made a 180° turn into takeoff position and requested a wind check. The tower controller stated that the wind was from a direction of 070 at eight knots with gusts to 14 knots. At 2355, the captain, who was the pilot flying (PF) began the takeoff roll. The tower controller said he saw the airplane begin its takeoff roll and that when the airplane was near where taxiway F intersected runway 11, he noticed sparks coming from the airplane. The controller said he thought the sparks were coming from the right main gear. He said from near taxiway F, he did not see the airplane slow down on the runway. He said the airplane maintained speed or accelerated from near taxiway F. The controller said he did not see the nose of the airplane come up or "any attempt to takeoff". He said the airplane continued in a straight line right off the end of runway 11. During the investigation, ground scars indicated that after departing runway 11, the airplane passed through the runway safety area, struck airport lighting structures, navigation facilities, the perimeter fence and some concrete posts outside the airport property. The airplane then crossed a road, struck an embankment, and came to a stop. The two crewmembers and two of the four passengers were fatally injured, and two passengers received serious injuries. The airplane was destroyed by post-crash fire.

2.0 FLIGHT CREW INFORMATION

The accident flight crew consisted of a captain and first officer. The Global Exec Director of Operations stated that the flight crew flew together for the first time on April 8, 2008 on a flight from Tucson International Airport (TUS), Tucson, Arizona to Long Beach Airport, (LGB), Long Beach Airport, Long Beach, California. The flight to LGB was 1.3 hours. They next flew together again the day before the accident on a maintenance test flight on the accident aircraft. The crew flew together for a second time on the day of the accident to reposition the aircraft from TEB to CAE.

Both crewmembers were current and qualified under Global Exec Aviation and FAA requirements.

2.1 Captain Sarah Hagar Lemmon

Captain Lemmon was 31 years old.

Date of hire with Global Exec Aviation: January 4, 2008

FAA records of Captain Lemmon indicated that:

Private Pilot - Airplane Single Engine Land certificate was issued on April 11, 1994.
Private Pilot - Airplane Single Engine Land – Instrument Airplane certificate was issued on May 28, 1997.
Private Pilot – Airplane Single Engine Land and Sea – Instrument Airplane certificate was issued on September 23, 1997
Private Pilot - Airplane Single and Multi-Engine Land – Airplane Single Engine Sea - Instrument Airplane – Multi Engine Limited to VFR only certificate was issued on December 6, 1997.
Commercial Pilot – Airplane Single Engine Land – Instrument Airplane – Private Privileges – Airplane Single Engine Sea and Multi Engine Land – Airplane Multi engine Land VFR Only was issued on March 29, 2001.

Flight Instructor- Airplane Single Engine certificate was originally issued on October 28, 2001.
Flight Instructor- Airplane Single Engine – Instrument Airplane certificate was originally issued on May 19, 2002.
Commercial Pilot – Airplane Single and Multi Engine Land – Instrument Airplane – Private Privileges - Airplane Single Engine Sea certificate was issued on September 1, 2004.
Flight Instructor – Airplane Single and Multi Engine – Instrument Airplane was originally issued on September 3, 2004.
Commercial Pilot – Airplane Single and Multi Engine Land – Instrument Airplane – CE500 (Subject to 25 hour SOE Limitation) - Private Privileges - Airplane Single Engine Sea certificate was issued on June 18, 2005.
Commercial Pilot – Airplane Single and Multi Engine Land – Instrument Airplane – CE500 - Private Privileges - Airplane Single Engine Sea certificate was issued on June 30, 2005.
Commercial Pilot – Airplane Single and Multi Engine Land – Instrument Airplane – CE500, CE560XL - Private Privileges - Airplane Single Engine Sea – CE560XL SIC Privileges Only certificate was issued on May 8, 2006.
Airline Transport Pilot – Airplane Multi-Engine Land- with CE500, CE560XL ratings – Commercial Pilot Privileges – Airplane Single Engine Land – Private Pilot Privileges – Airplane Single Engine Sea - CE560XL SIC Privileges Only certificate was issued on August 11, 2006.
A LR-60 type rating was added on October 25, 2007 and a CE-650 type rating was added on January 19, 2008.

Pilot certificates and ratings held by Captain Lemmon at time of the accident:

FLIGHT INSTRUCTOR (issued September 30, 2006)
AIRPLANE SINGLE AND MULTI ENGINE
INSTRUMENT AIRPLANE
VALID ONLY WHEN ACCOMPANIED BY PILOT CERTIFICATE

AIRLINE TRANSPORT PILOT (issued January 19, 2008)
AIRPLANE MULTIENGINE LAND
CE-500, CE-560XL, LR-60, CE-650
COMMERCIAL PRIVILEGES
AIRPLANE SINGLE ENGINE LAND
PRIVATE PRIVILEGES
AIRPLANE SINGLE ENGINE SEA
Limitations:
CE-560XL SIC PRIVILEGES ONLY

AIRCRAFT DISPATCHER (issued July 12, 2004)

MEDICAL CERTIFICATE FIRST CLASS (issued April 29, 2008)
Limitations: Holder shall wear corrective lenses

Training and Proficiency Checks:

Global Exec Aviation Initial New Hire training completed on January 4, 2008
Initial Type Rating LR-60: October 25, 2007
Initial Captain training in CE-650: January 19, 2008
Last recurrent simulator training: August 13, 2008
Last recurrent ground training: August 16, 2008
Last Line Check: May 6, 2008
Last Proficiency Check: August 14, 2008

Captain Lemmon received a NOTICE OF DISAPPROVAL on August 11, 2006 when she failed a practical test for her Airline Transport Pilot (ATP) certificate. She was unsatisfactory in the area of non-precision approach and circle to land. She was retested on August 11, 2006 and passed.

Captain Lemmon received a NOTICE OF DISAPPROVAL on November 14, 1997, when she failed a practical test for her Commercial Airplane Multi Engine Land (CAMEL) certificate. She was unsatisfactory in the areas of knowledge of National Air Space System and airplane Performance and Limitations. The flight test portion of the evaluation was not conducted. She was retested on September 1, 2004 and passed.

Captain Lemmon received a NOTICE OF DISAPPROVAL on April 11, 1997, when she failed a practical test for her private Pilot Airplane Instrument Rating certificate. She was unsatisfactory in the area of partial panel VOR[4] Instrument Approach Procedures and ILS[5] Instrument Approach Procedures. She was retested on April 14, 1997, and received a second NOTICE OF DISAPPROVAL. She was unsatisfactory in the area of partial panel VOR Instrument Approach Procedures. She was retested on May 28, 1997 and passed.

Flight Times: based on Global Exec Aviation employment records[6]

Total pilot flying time	3,140 hours
Total Pilot-In-Command (PIC) time	2,040 hours
Total LR-60 flying time	35 hours
Total LR-60 PIC time	8 hours
Total flying time last 24 hours	1 hours, 35 minutes
Total flying time last 7 days	2 hours, 23 minutes
Total flying time last 30 days	35 hours, 30 minutes
Total flying time last 60 days	53 hours, 10 minutes
Total flying time last 90 days	67 hours, 0 minutes
Total flying time last 12 months	144 hours, 10 minutes

A review of FAA records found no prior accident, incident or enforcement actions.

[4] VOR – Very High Frequency Omni-Range
[5] ILS – Instrument Landing System
[6] See attachment 2 – Global Exec Aviation Crewmember Logbook Report

Global Exec Aviation records indicated that, including the accident flight, Captain Lemmon had flown to CAE one time since January 2008.

Captain's 72-Hour History

Little information was available regarding the captain's non-work activities in the 72 hours prior to the accident.

On Wednesday, September 17, 2008, the captain flew on a commercial air carrier from Long Beach Airport (LGB), Long Beach, CA, to John F. Kennedy International Airport (JFK) in New York, NY. The captain boarded the flight at LGB at 1238 PDT and arrived at JFK at 2026 EDT (all times hereafter are EDT). The captain checked in to a hotel in Secaucus, NJ, at about 2200.

On Thursday, September 18, 2008, the captain received a cellular phone call at 0137 that lasted for 16 minutes. Based on the phone records and subsequent hotel wake-up call that morning at 0800, the captain had the potential for 6 hours of sleep that evening. The captain checked out of the hotel at 0950 and departed for TEB via the hotel shuttle van at about 1000. The hotel was approximately 5 miles from TEB for an estimated travel time of 8-10 minutes. The accident crew conducted a test flight on the accident aircraft that departed at about 1200 and lasted 48 minutes. At 1400, the captain checked in to a different hotel in Secaucus, NJ, and was off duty until the next day. No information was available regarding the captain's non-work activities for the remainder of the day with the exception of cellular phone activity.

On Friday, September 19, 2008, the captain placed a cellular phone call at 0037 that lasted 28 minutes. A call was also received on the captain's cellular phone at 0318 that lasted 1 minute. It is not known if the captain answered the phone call or not. A wake-up call was not requested from the hotel that morning but a text message was placed from the captain's cellular phone at 1052. Therefore, based on cellular phone records, the captain had the potential for 7.5-9.5 hours of sleep that evening. Later that day, the accident captain had several telephone communications with the company regarding possible charter flights. The accident captain was advised of a flight with a scheduled departure time of 2130 from TEB. The captain checked out from the hotel at 2018. It is not clear how the captain traveled to TEB, however, the hotel was approximately 15 miles from TEB for an estimated travel time of 21 minutes.

The accident crew departed TEB in the accident airplane at about 2142 for CAE. The flight arrived at Columbia Aviation ramp at the CAE airport at about 2310.

2.2 First Officer James Wade Bland

F/O Bland was 52 years old.

Date of hire with Global Exec Aviation: August 8, 2008

FAA records of F/O Bland indicated that:

Private Pilot - Airplane Single Engine Land certificate was issued on November 21, 1974.

Private Pilot - Airplane Single and Multi Engine Land certificate was issued on January 12, 1975.
Commercial Pilot – Airplane Single and Multi Engine Land certificate was issued on June 3, 1975.
Commercial Pilot – Airplane Single and Multi-Engine Land – Instrument Airplane certificate was issued on August 27, 1975.
Commercial Pilot – Airplane Single and Multi-Engine Land – Instrument Airplane – Rotorcraft - Helicopter certificate was issued on May 13, 1983.
Commercial Pilot – Airplane Single and Multi-Engine Land – Instrument Airplane And Helicopter – Rotorcraft - Helicopter certificate was issued on April 6, 1984.
Repairman – Certificate Privileges of FAR Section 65.103 Valid For Radio Installer While Employed By A.H. Electronics, LTD., Oklahoma City, OK certificate was issued on July 24, 1989.
Airline Transport Pilot – Airplane Multi-Engine Land with CE 500 rating – Commercial Privileges –Airplane Single Engine Land – Rotorcraft – Helicopter – Instrument Helicopter certificate was issued on January 18, 1992.
A type rating on the LR-60 was added on March 1, 2007.

Pilot certificates and ratings held by F/O Bland at time of accident:

AIRLINE TRANSPORT PILOT (issued March 1, 2007)
AIRPLANE MULTIENGINE LAND
CE-500, LR-60
COMMERCIAL PRIVILEGES
AIRPLANE SINGLE ENGINE LAND;
ROTORCRAFT – HELICOPTER;
INSTRUMENT HELICOPTER

MEDICAL CERTIFICATE FIRST CLASS (issued July 18, 2008)
Limitations: MUST WEAR CORRECTIVE LENSES
POSSESS GLASSES FOR NEAR / INTERMEDIATE VISION

Training and Proficiency Checks:

The accident F/O had no flight training on the airplane under Global Exec's training program. He had Learjet 60 pilot-in-command (PIC) and second-in-command (SIC) flight training and a proficiency check at his previous company, Executive Jet Management. Global Exec and the FAA accepted[7] the training as both Executive Jet Management and Global Exec used the same training program and the same training facility for Learjet 60 training. The F/O did attend Global Exec ground school which included basic indoctrination and procedures. Captain Perrigoue said he flew with the accident F/O for a few legs which totaled about 5 flight hours.

[7] Accepted – the FAA can "accept" training by a previous employer in lieu of requiring training if it determines that the previous training was sufficient.

Global Exec Aviation Initial New Hire training completed on August 8, 2008
Initial Type Rating LR-60: March 1, 2007
Last Proficiency check on LR-60: March 13, 2008

Flight Times: based on Global Exec Aviation employment records[8] and estimates from additional employer, McGraw Group[9], and previous employer, Executive Jet Management (EJM):

Total pilot flying time	8,200 hours
Total PIC time	7,500 hours
Total flying time in LR-60	300 hours
Total LR-60 second-in-command (SIC) time	108 hours 6 minutes
Total flying time last 24 hours	1 hour 35 minutes
Total flying time last 7 days	4 hours, 0 minutes
Total flying time last 30 days	34 hours, 0 minutes
Total flying time last 60 days	41 hours, 54 minutes
Total flying time last 90 days	41 hours, 54 minutes
Total flying time last 12 months	166 hours, 54 minutes

A review of FAA records found no prior accident, incident or enforcement actions.

Global Exec Aviation records indicated that, including the accident flight, First Officer Bland had flown to CAE one time since August 2008.

First Officer's 72-Hour History

Little information was available regarding the FO's non-work activities in the 72 hours prior to the accident.

The FO's wife stated that her husband went to bed around 2200 PDT on Tuesday, September 16, 2008. The FO awoke at 0700 PDT on Wednesday, September 17, 2008, for his flight later that day. The FO flew on a commercial flight from LGB to JFK. The FO boarded the flight at LGB at 1238 PDT and arrived at JFK at 2026 EDT (all times hereafter are EDT). The FO checked in to a hotel in Secaucus, NJ, at about 2200 and sent his wife a text message that evening to let her know he had arrived.

On Thursday, September 18, 2008, cellular phone records indicated data usage on the FO's phone at 0005 and again at 0720. It is unknown the length of time of this usage. Based on the

[8] See attachment 2 – Global Exec Aviation Crewmember Logbook Report
[9] Interviews indicated that First Officer Bland started working for McGraw group in August 2008. The Global Exec Aviation Director of Operations indicated that he was not aware that First Officer Bland was working for another company concurrently.

phone records and data usage, the FO had the potential for 7 hours of sleep that evening. A wake-up call from the hotel had been placed for 0800. The FO checked out of the hotel at 0950 and departed for TEB via the hotel shuttle van at about 1000. The hotel was approximately five miles from TEB for an estimated travel time of 8-10 minutes. The accident crew conducted a test flight on the accident aircraft that departed at about 1200 and lasted 48 minutes. At about 1400, the FO checked into a different hotel in Secaucus, NJ, and was off duty until the next day. His wife stated that they exchanged text messages and spoke on the phone that day. According to his wife, the FO stated that the crew had changed hotels because excessive noise at the first hotel had made it difficult to sleep. No additional information was available regarding the FO's non-work activities for the day.

On Friday, September 19, 2008, cellular phone records indicated data usage on the FO's phone at 0005. It is unknown the length of time of this usage. A wake-up call was not requested from the hotel that morning but a text message was placed from the FO's cellular phone at 0947. Therefore, based on cellular phone usage, the FO had the potential for 9.75 hours of sleep that evening. No information, beyond cellular phone records, was available regarding the FO's non-work activities until check out from the hotel at 2018. It is not clear how the FO traveled to TEB; however, the hotel was approximately 15 miles from TEB for an estimated travel time of 21 minutes.

The accident crew departed TEB in the accident airplane at about 2142 for CAE. The flight arrived at Columbia Aviation ramp at about 2310.

The FO's wife stated that she talked to him just before the flight at 2334.

3.0 WEIGHT AND BALANCE

Global Exec Aviation was authorized by Operations Specifications Paragraph A096[10] to use "only actual weights" when determining the airplane weight and balance. The Operations Specifications paragraph A096 issued to Global Exec Aviation stated, in part:

> *a. The certificate holder is authorized to use <u>only actual</u> weights when determining the aircraft weight and balance.*
> *(1) This includes the passenger weights, carry-on bag weights, checked bag weights, plane-side loaded bag weights, and heavy bag weights, and/or*
> *(2) Actual weights of all passengers and bags or solicited ("asked") passenger weight plus 10 pounds and actual weight of bags.*

A Revised Weight Record[11] dated September 2, 2008, indicated the Empty Weight of the accident airplane was 14,755 lbs.

Fuel onboard the airplane was 7,800 lbs. and this was determined from the flight plan filed by the accident flight crew on Honeywell Global Data Center.

[10] See attachment 3 – Operations Specifications A096
[11] Weight Record – an approved form documenting the weighed weight of the airplane.

Taxi and APU Fuel Burn was 150 lbs. and was determined using the Learjet 60 airplane operating manual.

Maximum Takeoff Weight Allowed was 23,500 lbs. and was determined using the Learjet 60 airplane operating manual.

Global Exec Aviation utilized Ultra-Nav software and an American Aeronautics Plotter to calculate airplane loading and center of gravity. In accordance with FAR 135.63 (d) the pilot in command carried the weight and balance manifest on board the airplane. The weight and balance manifest and the American Aeronautics Plotter were destroyed by post crash fire.

Due to the destruction of the weight and balance manifest and damage to the baggage caused by post crash fire, investigators were unable to precisely determine the actual weight of the passengers and baggage loaded on the airplane. Without exact weights, it could not be stated whether the accident airplane was within weight and balance limits.

4.0 AERODROME INFORMATION

Airport information was obtained from the Federal Aviation Administration's National Aeronautical Charting Office (NACO) Terminal Procedures Publication (TPP) and Airport Facility Directory (AFD). At the time of the accident, Columbia Metropolitan Airport elevation was 236 feet above mean sea level (MSL), and was located five miles southwest of the city of Columbia, South Carolina. The airport had two hard surface runways. NACO data indicated runway 11/29 was grooved asphalt and was 8,601 feet long and 150 feet wide. Runway 5/23 was grooved asphalt and concrete and was 8,001 feet long and 150 feet wide. At the time of the accident, runway 5/23 was closed for construction.

Runway 11 had precision runway markings, high intensity runway lights (HIRL), centerline lights (CL), touchdown zone lights (TDZ), high intensity approach lighting system with centerline sequenced flashers (ALSF2), a precision approach path indicator (PAPI), and touchdown, midfield, and rollout runway visual range indicators (RVR). Runway 29 had precision runway markings, high intensity runway lights (HIRL), centerline lights (CL), a medium intensity approach lighting system with runway alignment indicators (MALSR), a precision approach path indicator (PAPI), touchdown, and rollout runway visual range indicators (RVR).

NOTAM # 08-75 stated that runway 5/23, taxiway HH, taxiway GG, and taxiway A between taxiway N and taxiway U south of taxiway F were closed for pavement maintenance until further notice. The NOTAM stated that runway closures were marked with lighted X's over the runway designators and taxiway closures were marked with lighted barricades. This information was on the ATIS[12] the day of the accident. The ATIS in effect at the time of the accident was:

> "Columbia airport information Victor…zero two five six Zulu, wind zero six zero at one zero, visibility ten, sky clear below one two thousand, temperature two one, dewpoint one three, altimeter three zero two one, visual approaches runway one one in use. Notice to

[12] ATIS – Automatic Terminal Information Service

airmen, runway five, two three closed. Taxiways golf golf, hotel hotel, alpha between November and uniform, and yankee south of taxiway foxtrot closed. ILS hold short sign runway 29 at taxiway uniform out of service. Clearance delivery and ground control combined on frequency one two one point niner. Read back all hold short instructions. Advise you have victor."

5.0 COMPANY OVERVIEW

Global Exec Aviation was founded in 2002 for on demand charter services using managed airplanes based in Southern California. At the time of the accident, Global Exec Aviation operated nine airplanes; two Gulfstream GIV's, 3 Gulfstream GIII's, a Falcon 50, a Cessna CE-650 (Citation VII), a Conquest 441 which was grounded by a Supplemental Inspection Document (SID), and a Learjet 60 (the accident airplane). Global Exec Aviation had 20 employees, including 11 full time pilots and they also utilized some part time pilots for some flight operations.

The accident airplane was purchased by Inter Travel and Services, Inc. in October 2007 and was managed and operated by Global Exec Aviation for FAR Part 91 flights until August 2008 when Global Exec Aviation began to operate it for FAR Part 135 on demand charter flights. The airplane was listed in Global Exec Aviations Operations Specifications (Ops Specs) under section D085 - Aircraft Listing.

Global Exec Aviation completed an inspection by the Federal Aviation Administration (FAA) Operational Control Emphasis group in 2007. The results of the inspection were satisfactory.

6.0 PREFLIGHT INSPECTION

Federal Aviation Regulations part 91.7, Civil Aircraft Airworthiness, stated in part:

> *(a) No person may operate a civil aircraft unless it is in an airworthy condition.*
> *(b) The pilot in command of a civil aircraft is responsible for determining whether that aircraft is in condition for safe flight. The pilot in command shall discontinue the flight when unairworthy mechanical, electrical, or structural conditions occur.*

Federal Aviation Regulations part 135.25 Aircraft requirements (A), stated in part: no certificate holder may operate an aircraft under this part unless that aircraft - (2) Is in an airworthy condition and meets the applicable airworthiness requirements of this chapter, including those relating to identification and equipment.

The Global Exec Aviation Operations Manual Section 10 – Normal Operating Procedures, paragraph 6 – Preflight Inspection, page 10-3 dated 3/01/07 (REV 0) stated in part:

> *In the case of a multi-leg trip, a preflight inspection will be performed prior to each leg. A walk-around inspection of the aircraft will be performed prior to each flight.*

The preflight inspection can be conducted by either the PIC or the SIC, although the PIC retains responsibility for ensuring that an adequate inspection was performed.

The Bombardier Learjet 60 Crew Checklist and Quick Reference Handbook chapter N – Normal Procedures – Exterior Preflight, page N-3 and N-4 dated February 1999 stated in part:

25. Right Main Strut & Wheel Well ..... CHECK
26. Right Main Landing Light & Doors ..... CHECK
27. Right Main Wheels, Tires & Brakes ..... CHECK

60. Left Main Strut & Wheel Well .....CHECK
61. Left Wheels, Tires & Brakes..... CHECK

Interviews conducted with the Director of Operations and flight crew members at Global Exec Aviation indicated that the company procedure was to conduct airplane preflight walk around procedures while referencing the Bombardier Learjet 60 Crew Checklist and Quick Reference Handbook.

Video evidence obtained from a security camera at Teterboro Airport indicated that the crew performed a preflight walk around inspection prior to the first flight of the day in the accident airplane. Due to the nature and quality of the video, the precision of the preflight could not be determined. Eyewitness accounts provided inconclusive evidence that the crew conducted a post flight walk around inspection after arrival at CAE or a preflight walk around inspection prior to the accident flight.

During the investigation, investigators determined from interviews conducted that the "Wheels, Tires & Brakes…….CHECK" item in the Bombardier Learjet 60 Crew Checklist and Quick Reference Handbook chapter N – Normal Procedures was interpreted by flight crews and instructors to mean a visual inspection of the "general condition" of the tires and components to determine if there was excessive wear, sidewall bulges, visible tire cord, or noticeable under inflation of the tires.

The Bombardier Learjet 60 AFM page 2-4, item 5 (j) and page 2-7 item 23 (c) state in part:
" Gear Wheels, Brakes, and Tires – Condition"

One Learjet 60 crewmember interviewed stated that under inflation of the airplane tires could be detected by visual inspection if the under inflation was "significant". All other Lear 60 crewmembers and instructors interviewed said they believed it was difficult to determine by visual inspection if tires were under-inflated. The task of determining under inflation by visual inspection was especially difficult in a dual wheel landing gear system if the adjacent tire was properly inflated and carrying the load of the airplane.

Post-accident, Bombardier Learjet issued an Advisory Wire 32-045[13] dated October 13, 2008. Section 4 of the Advisory Wire stated in part: *"proper tire inflation cannot be determined visually."*

[13] See Attachment 4 – Advisory Wire 32-045 -

Investigators also determined that, except for the one instance mentioned below, Learjet 60 flight crews were not expected to, nor were they trained to check tire pressures at any time. One Learjet 60 flight crew member stated that a tire pressure gauge was carried on board the airplane at his place of employment and a pilot could use the pressure gauge if tire inflation was questionable. All other Learjet 60 flight crews and instructors interviewed stated that checking tire pressures was a maintenance function.

Post-accident, in March 2009, Bombardier Learjet issued a Learjet 60/60XR Temporary Flight Manual (TFM) Change titled TFM 2009-03[14]. This TFM stated in part:

> *The following summary describes the changes that are incorporated with this temporary flight manual change.*
>
> ***LIMITATIONS***
>
> ***SYSTEM LIMITS***
>
> *Nose and main tire pressures must be checked within 96 hours (not flight hours) prior to takeoff using the procedures listed in Chapter 12 of the Learjet 60 Maintenance Manual.*
>
> *Add note to check tire pressure for aircraft parked more than 10 consecutive days.*
>
> *Added table with allowable tire pressure range based on Maximum certified takeoff weight.*
>
> ***NORMAL PROCEDURES***
>
> ***EXTERIOR PREFLIGHT***
>
> *Added three additional steps to check nosewheel and main tire pressures.*

On February 26, 2009, the FAA issued a response to a "Request for Interpretation of Applicable Rules in C.F.R. parts 43, 91, and 135 Pertaining to Whether a Pilot of a Transport Category Aircraft May Check Tire Pressure During a Normal Preflight Inspection"[15]. In response to a question whether a pilot could check tire air pressure on a Learjet 60 aircraft, the response letter stated in part:

> *…a pilot operating the aircraft under the operating rules of 14 C.F.R. part 91 may, in accordance with the provisions of 14 C.F.R. regulation 43.3 (g), perform daily landing gear tire pressure checks. Under the same regulation, a pilot operating under 14 C.F.R part 135 may not perform that task.*

The response letter further stated that a carrier could seek an exemption from the FAA for the regulation.

[14] See attachment 5 – Bombardier Learjet 60/60X Temporary Flight Manual Change dated March 2009
[15] See Attachment 6 – FAA Interpretation

7.0 TAXI

7.1 Global Exec Aviation taxi procedures

The Global Exec Aviation Operations Manual Section 10 – Normal Procedures, paragraph 14 – Taxiing, page 10-6 dated 3/01/07 (REV 0) stated in part:

> *The FAA strongly recommends that training in runway safety and the specific SOP's contained in AC 91-73 and 20-74 be incorporated into Company operations including, but not limited to:*
>
> *• Read back all runway crossing and/or hold short instructions*
> *• Review airport layouts as part of preflight planning and before descending to land, and while taxiing as needed*
> *• Review Airmen (NOTAM) for information on runway/taxiway closures and construction areas*
> *• Do not hesitate to request progressive taxi instructions from ATC when unsure of the taxi route*
> *• Check for traffic before crossing any runway hold line and before entering a taxiway*
> *• Turn on aircraft nav lights and rotating beacon while taxiing*
> *• When landing, clear the active runway as quickly as possible then wait for taxi instructions before further movement*
> *• Study and use proper radio phraseology as described in the Aeronautical Information Manual in order to respond to and understand ground control instructions*
> *• Write down complex taxi instructions at unfamiliar airports*

7.2 Accident Flight Taxi Route

The accident flight crew received a clearance to taxi from Columbia Aviation to runway 11 via taxiway U and across runway 23 at the approach end of runway 23. Due to construction and the closure of runway 5/23 and taxiways A and GG, the taxi clearance required a right turn out of the parking area which was a turn away from the runway of intended use[16]. After the accident crew made a left turn out of parking, the Ground Controller issued an amended taxi clearance to runway 11 via taxiway U and a back taxi on runway 11.

8.0 TAKEOFF PROCEDURES

8.1 Take off briefing

[16] See attachment 7 – Accident flight taxi route

The Global Exec Aviation Operations Manual Section 10 – Normal Operating Procedures, paragraph 6 – Preflight Inspection, page 10-7 dated 3/01/07 (REV 0) stated in part:

> *Takeoff briefings will be conducted by the PF prior to each takeoff.*
>
> *Takeoff may be a full or abbreviated briefing at the discretion of the PIC. Generally, a full briefing will be conducted for the first flight of the day for a particular crew pairing. A full briefing will include the following:*
>
> *a. abort procedure prior to V1,*
> *b. procedure to be followed in case of a problem after V1,*
> *c. minimum safe altitude for flap retraction / running checklists,*
> *d. emergency return plan,*
> *e. and the normal takeoff plan (initial departure procedure, altitude, squawk, and departure frequency).*
>
> *An abbreviated briefing will include the words **"standard brief"** and will include letters c. thru e. above.*

8.2 Normal Takeoff

Normal takeoff procedures were contained in the Global Exec Aviation Part 135 Training Program Manual Appendix Learjet 60, and the Flight Safety International Learjet 60 Pilot Training Manual. Both manuals were issued to crewmembers.

The Global Exec Aviation Part 135 Training Program Manual Appendix Learjet 60, page D-62, revision 12 dated June 12, 2008, included a pictorial representation of the normal takeoff profile.[17]

The Flight Safety International Learjet 60 Pilot Training Manual, Chapter Maneuvers and Procedures, page MAP-4 states in part:

> *TAKEOFF PROCEDURES*
>
> *When cleared for takeoff the PF calls for Runway Lineup Checklist. The PNF reports, "Runway Lineup Checklist complete, cleared for takeoff." The PF advances power to the takeoff thrust detent. The PNF confirms the N_1 setting matches the N_1 bug.*
>
> *At V_1 speed, the PNF calls, "V_1". The PF releases the thrust levers and puts both hands on the control column.*
>
> *At V_R, the PNF calls "rotate". The PF rotates the airplane to a 9º nose-up pitch attitude.*

[17] See attachment 8 – Global Exec Aviation Takeoff Profile

The Flight Safety International Learjet 60 Pilot Training Manual, Chapter Maneuvers and Procedures, page MAP-11 contained a pictorial representation of the normal takeoff profile that was compatible with the one contained in the Global Exec Aviation Training Program Manual listed previously.

9.0 ABORTED TAKEOFF GUIDANCE

Guidance, other than for an engine failure, to be used in determining if an aborted takeoff was necessary was not contained in the Learjet 60 Aircraft Flight Manual (AFM), Learjet Pilot Manual, Learjet Training Manual, Global Exec Aviation Operations Manual or in the Flight Safety International Learjet 60 Pilot Training Manual which was approved for use by Global Exec Aviation for flight crew training.

Interviews with Global Exec Aviation pilots, as well as Learjet 60 instructors, pilots, and industry professionals indicated that all used nearly the same criteria to determine whether or not to abort a takeoff. During the low speed regime up to 80 knots, pilots interviewed stated that they would abort the takeoff for any abnormal or emergency event. During the high speed regime, from 80 knots up to V_1, the pilots would abort the takeoff only for an engine fire, engine failure, an engine thrust reverser deployment, or a loss of directional control. Some interviewees indicated they would consider abnormal acceleration or deceleration elements of directional control. Above V_1 speed, the takeoff would be continued.

The Global Exec Aviation Part 135 Training Program Manual Appendix Learjet 60, page D-64 and D-65, revision 12 dated June 12, 2008, included pictorial representations of an aborted takeoff due to engine failure and a continued takeoff in the event of an engine failure at or after V1.[18]

The Flight Safety International Learjet 60 Pilot Training Manual, Chapter Maneuvers and Procedures, page MAP-14 contained pictorial representations compatible with those in the Global Exec Aviation Manual and also included the following guidance on page MAP-13:

> *ENGINE FAILURE BELOW V_1 SPEED*
>
> *If an engine fails below V_1 speed (Figure MAP-3), the takeoff must be aborted. The PF will simultaneously apply maximum braking, reduce thrust levers to idle, and extend the spoilers. The thrust reversers may be deployed if necessary.*
>
> *Takeoffs may be aborted for malfunctions other than engine failures; however, the same procedure should normally be used.*
>
> *ENGINE FAILURE ABOVE V_1 SPEED*
>
> *If an engine fails above V_1 speed (Figure MAP-4), the takeoff will normally be continued. The PF will maintain directional control with ailerons and rudder and keep the nosewheel on the runway until reaching rotate speed. After liftoff, the initial climb will be made at V_2 speed with*

[18] See attachment 9 – Global Exec Aviation Abort Takeoff Profiles

the takeoff flaps until the airplane is clear of obstacles or, if there are no obstacles, to 1,500 feet AGL.

The Bombardier Learjet 60 Pilot Training Guide annex 1 rev 2 stated in part:

The PF should execute an abort prior to 90 KIAS for any abnormality observed. Between 90 and V1, the PF commands and executes the aborted takeoffs for:

- *Engine failure*
- *Engine fire*
- *Loss of directional control*
- *Thrust reverser deployment*
- *Catastrophic failures*

The Bombardier Learjet 60 Crew Checklist and Quick Reference Handbook provided the emergency procedure for use in the event of an aborted takeoff. The procedure, page E-19, stated the following (bolded items as stated in handbook) in part:

ABORTED TAKEOFF

1. *Brakes.....APPLY*
2. *Thrust Levers.....IDLE*
3. *Spoilers.....EXT*
4. *Thrust Reversers .....AS REQ'D*
5. *If turn-around brake energy weight or landing maximum brake energy weight was exceeded, refer to the AFM for further disposition.*

Post-accident, in March, 2009, Bombardier Learjet issued a Learjet 60/60XR Temporary Flight Manual (TFM) Change titled TFM 2009-03[19]. This TFM stated in part:

[from Highlights-1 page of the TFM Change]

ABNORMAL PROCEDURES
ABORTED TAKEOFF

Provides additional information to help crew recognize that FORWARD thrust (not reverse thrust) is being applied because of a malfunction of the thrust reverser system.

[from page 6 of TFM]

Added NOTE and WARNING, revised step 4 and added new step to Aborted Takeoff procedure:

[19] See attachment 5 - Bombardier Learjet 60/60X Temporary Flight Manual Change dated March 2009

Thrust Reversers – Deploy, if necessary. Check for TR Deploy lights illuminated.[20]

If none of the TR Lights are illuminated, both Thrust Reversers Levers – Stow.

***NOTE**: The normal sequence of each engine's annunciators are as follows:*

- *Green TR ARM – Thrust Reverser ready to deploy.*
- *Green TR ARM and Amber TR UNLOCK – Thrust Reverser in transit.*
- *Green TR ARM and White TR DEPLOY – Thrust Reverser fully deployed (reverse thrust greater than idle is possible when both engine's thrust reversers have been fully deployed).*

***WARNING:** - A damaged squat switch (or other failures) may cause the thrust reverser auto stow system to activate (both engine's clamshell doors will stow), resulting in **FORWARD** thrust, ranging from idle to near takeoff power, depending on thrust reverser **LEVER** position. If this occurs, thrust reversers **LEVERS** must be stowed immediately.*

*- Squat switch failure with the thrust reversers deployed will be indicated by the white TR DEPLOY lights extinguishing and the amber TR UNLOCK lights illuminating for a few seconds, then extinguishing. The green TR ARM lights will flash during the transition, then extinguish. **In summary, the absence of any TR lights indicates forward thrust.** There may also be a change in acceleration as the engines transition from reverse thrust to forward thrust.*

In 1994, the FAA published Advisory Circular (AC) 120-62: Takeoff Safety Training Aid, with the purpose of providing guidance to "minimize, to the greatest extent practical, the probability of RTO-related accidents and incidents". Although the AC guidance applies to FAR Part 121 operators, it is also stated that "many of the principles, concepts and procedures described apply to operations under FAR Parts 91, 129, and 135 for certain aircraft and are recommended for use by those operators when applicable". The AC provides definitions of speeds and guidance for training.

Specifically, the AC defines V_1 speed in the following way:

a. V1. The speed selected for each takeoff, based upon approved performance data and specified conditions, which represents:

(1) The maximum speed by which a rejected takeoff must be initiated to assure that a safe stop can be completed within the remaining runway, or runway and stopway;

[20] The TR Deploy lights are located at the top of the forward instrument panel.

(2) The minimum speed which assures that a takeoff can be safely completed within the remaining runway, or runway and clearway, after failure of the most critical engine at a designated speed; and

(3) The single speed which permits a successful stop or continued takeoff when operating at the minimum allowable field length for a particular weight.

Note 1: Safe completion of the takeoff includes both attainment of the designated screen height at the end of the runway or clearway, and safe obstacle clearance along the designated takeoff flight path.

Note 2: Reference performance conditions for determining V1 may not necessarily account for all variables possibly affecting a takeoff, such as runway surface friction, failures other than a critical powerplant, etc.

In addition, the AC provides the following guidance for training:

8. TRAINING AID KEY PROVISIONS. The following key elements of the takeoff safety training aid are recommended, as a minimum, for implementation by each air carrier.

a. Ground Training. The ground training program should ensure thorough crew awareness in at least the following topics:

(1) Proper RTO and takeoff continuation procedures in the event of failures;

(2) Potential effects of improper procedures during an RTO;

(3) Guidelines on rejecting or not rejecting a takeoff in the low and high speed regimes;

(4) Assigned crewmember duties, use of comprehensive briefings, and proper crew coordination;

(5) Appropriate selection of runway, flap settings, thrust levels, weight and V speeds relative to takeoff conditions (gross runway contaminants, etc.);

(6) Proper use of "reduced VI" policies if used; and

(7) The increased stopping distance required on slippery or contaminated runways.

b. Flight Training and Checking. Flight training programs and airmen evaluations, to the extent appropriate, using an approved simulator should ensure appropriate crew skill in applying the items listed in (a) above. Simulator scenarios should include the following conditions and procedures:

(1) Use of critical weights for a specified runway (e.g., critical field length/balanced field length).

(2) Demonstration of the increased stopping distance required on slippery or contaminated runways.

(3) Demonstration of the proper and appropriate crew responses for engine failure, tire failure, nuisance alerts, and critical failures that affect the ability to safely continue the takeoff in both the high and low speed regimes.

In addition to the FAA guidance, many operators in the industry used a training video produced by Boeing to provide flight crew training on rejected takeoffs. Global Exec Aviation Director of Operations stated that the company used a Boeing video which discussed statistical safety on high speed rejected takeoffs. He stated that the message communicated by the video was "do not do high speed aborts".

10.0 INADVERTANT STOW OF THRUST REVERSER AFTER A CREW-COMMANDED DEPLOYMENT PROCEDURE

During certification, Bombardier Learjet developed an abnormal procedure for use in the event of an uncommanded[21] stowage of the engine thrust reversers. Bombardier Learjet subsequently amended the procedure in November 2001. At the time of the accident, it was an emergency procedure to be performed by memory titled "Inadvertent Stow Of Thrust Reverser After A Crew-Commanded Deployment". The procedure, located in the Bombardier Learjet 60 Crew Checklist and Quick Reference Handbook stated in part:

INADVERTENT STOW OF THRUST REVERSER
AFTER A CREW-COMMANDED DEPLOYMENT

1. *Maintain control with rudder, aileron, nosewheel steering & brakes.*
2. *Both Thrust Reverser Lever.....STOW*

NOTE *Failure to move the thrust reverser levers to stow will result in forward thrust ranging from idle to near takeoff power, depending upon the position of the thrust reverser levers.*

The first two items on the checklist were emphasized by enclosure in a box to indicate procedures that "should be memorized for crew accomplishment without reference to the procedure."[22] The expanded version of this emergency procedure found in the Bombardier Learjet 60 Airplane Flight Manual (AFM), page 3-32, also included the following note:

[21] The term "uncommanded stowage" was commonly used to describe the loss of requirements to maintain thrust reverser deployment after a crew-commanded deployment. Procedures for an uncommanded stowage of thrust reversers are the same as those for Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment.

[22] Bombardier Learjet 60 Crew Checklist and Quick Reference Handbook

Post-accident, in March, 2009, Bombardier Learjet issued a Learjet 60/60XR Temporary Flight Manual (TFM) Change titled TFM 2009-03[23]. This TFM stated in part:

[from page 7 of the TFM Change]

> *Changed the NOTE to a WARNING in INADVERTENT STOW OF THRUST REVERSER AFTER A CREW-COMMANDED DEPLOYMENT procedure:*
>
> ***WARNING:*** *- A damaged squat switch (or other failures) may cause the thrust reverser auto stow system to activate (both engine's clamshell doors will stow), resulting in* ***FORWARD*** *thrust, ranging from idle to near takeoff power, depending on thrust reverser* ***LEVER*** *position. If this occurs, thrust reversers* ***LEVERS*** *must be stowed immediately.*
>
> *- Squat switch failure with the thrust reversers deployed will be indicated by the white TR DEPLOY lights extinguishing and the amber TR UNLOCK lights illuminating for a few seconds, then extinguishing. The green TR ARM lights will flash during the transition, then extinguish.* ***In summary, the absence of any TR lights indicates forward thrust.*** *There may also be a change in acceleration as the engines transition from reverse thrust to forward thrust.*

Interviews conducted with flight crews of Learjet 60 airplanes, flight instructors, and various industry professionals who operated Learjet 60 airplanes, indicated an awareness of the possibility of an Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment. The interviews indicated that there was not a comprehensive awareness of the possibility of forward thrust occurring as a result of an Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment.

During normal operation of the engine thrust reversers, there were six flight deck annunciator lights (three for each of the left and right thrust reversers) associated with the system to provide information to flight crews regarding the status of the engine thrust reversers. The first two lights are green TR ARM[24] lights indicating that the prerequisite conditions are met and hydraulic pressure is available to deploy the thrust reversers. The TR ARM lights illuminate when (1) the aircraft is on the ground with both squat switches indicating weight on wheels (this is known as ground mode), and (2) the applicable engine thrust lever is in the idle position. Raising the engine thrust reverser levers to the deploy detent allows application of hydraulic pressure to unlock the engine reverser doors and illuminates the amber TR UNLOCK[25] lights. When the engine thrust reverser doors are fully deployed, in a position to provide reverse thrust, a signal is sent to extinguish the amber TR UNLOCK lights and illuminate the white TR DEPLOY[26] lights.

The thrust reversers were designed to fail to the forward thrust position to prevent reduction of pilot control in flight. While on the ground, if there were an Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment, due to a loss of the requirements for maintaining reverse thrust:

[23] See attachment 5 – Bombardier Learjet 60/60X Temporary Flight Manual Change dated March 2009
[24] TR ARM – Thrust reverser armed
[25] TR UNLOCK – Thrust reverser unlocked
[26] TR DEPLOY – Thrust reverser deployed

- The thrust reverser doors would move to the closed position;

- The white TR DEPLOY light(s) would extinguish because the thrust reversers would no longer be at the fully deployed position(s);

- The amber TR UNLOCK light(s) would illuminate momentarily during transition, and then extinguish when the thrust reversers reach the fully stowed position(s)

- The green TR ARM lights would illuminate momentarily if the problem were loss of the required "on ground" squat switch circuit; and

- The takeoff checklist called for inhibiting the amber MASTER CAUTION lights[27] to prevent transient nuisance warnings.[28] If the lights had not been inhibited, they would illuminate momentarily on the forward instrument panel for 1 or 2 seconds when the TR UNLOCK lights illuminated.

Once the thrust reverser doors moved to the forward thrust position, no annunciator lights would remain illuminated. The only indication available to the pilots that the cockpit reverse levers and the engine thrust reversers were not in agreement would be the pilot's comprehension that the TR DEPLOY lights were dark while the reverse levers were in the positions normally associated with reverse thrust.

Following the Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment, there would be no annunciator lights illuminated on the flight deck to indicate the status of the reversers. Interviews indicated there were varying expectations in the Learjet 60 community of what lights and indications would be presented in the event of an uncommanded stowage of the thrust reversers.

10.1 Master Caution

The Bombardier Learjet 60 incorporated a master caution and warning system that included two combination red / amber master warning / caution lights. One light was located on each of the pilot's and co-pilot's instrument panel. Illumination of any amber cockpit annunciator lights, except starter engaged lights (during ground operations), would normally cause both amber MASTER CAUTION lights to illuminate and flash unless the master caution feature had been inhibited.

10.2 Master Caution Inhibit Procedure

[27] Learjet 60 airplanes have two MASTER CAUTION lights. One light is located on the pilot's instrument panel below the main annunciator panel; the other light is located on the co-pilot's instrument panel below the main annunciator panel. The upper half of each light is labeled "WARN" and illuminates red when a red annunciator panel light illuminates. The lower half of each light is labeled "CAUT" and illuminates amber when an amber annunciator panel light illuminates.

[28] In addition, if the pilot inhibits the MASTER CAUTION light before takeoff to reduce nuisance warnings, the airplane would have to be in air mode for 10 seconds before the MASTER CAUTION light would illuminate.

To prevent nuisance illumination, the Master Caution lights could be inhibited from illuminating while on the ground and during takeoff. When the airplane was on the ground, the master caution feature could be inhibited by depressing and holding either Master WARN/CAUTION light until the Master CAUT light illuminated steadily. Approximately ten seconds after takeoff, the master caution feature would revert to the normal [uninhibited] mode. Even if the Master Caution lights were inhibited, the amber annunciator lights would still illuminate if necessary. In accordance with standard operating procedures on the Learjet 60, the master caution system was to be inhibited by the flight crew prior to engine start. Item number (23) of the Before Starting Engines Checklist contained in the Bombardier Learjet 60 Crew Checklist and Quick Reference Handbook read as follows:

23. Master CAUT……..INHIBIT

The Bombardier 60 Pilot's Manual, page 4-35, change 3, stated that once inhibited on the ground, and unless the flight crew canceled the inhibit, the master caution system remained inhibited until approximately 10 seconds after takeoff, when the master caution feature reverted to the normal (uninhibited) mode. The master caution system was inhibited in order to avoid nuisance warnings during ground operations and takeoff.

11.0 TRAINING

Global Exec Aviation was authorized by FAA Operations Specifications paragraph A031, to conduct training, testing, and checking under agreement with the Flight Safety International (FSI) Learning Center in Tucson, AZ. Crewmembers received Basic Indoctrination training from Global Exec Aviation. The remainder of ground training, and all flight simulator training and checking was conducted by FSI.

11.1 Aborted Takeoff Training

Although Global Exec Aviation General Operating Manual did not contain guidance on aborted takeoff criteria, all of the Global Exec Aviation pilots interviewed stated that they used similar criteria to determine when a takeoff would be aborted, as noted in section 9.0 above.

Bombardier Learjet did not include aborted takeoff criteria in the Learjet 60 flight manuals but had published some guidance in the pilot training guide, as noted previously.

FSI did not include guidance on aborted takeoff criteria, other than for an engine failure, in the pilot training manuals that were provided to investigators, and did not provide any supplementary training documents that included aborted takeoff criteria to investigators when requested.

In the Temporary Flight Manual change dated March, 2009[29], Bombardier Learjet added a warning to its "Aborted Takeoff" and its "Inadvertent Stow of Thrust Reverser After a Crew-Commanded Deployment" procedures; the warning advised Learjet 60 operators that a damaged squat switch could potentially cause uncommanded thrust reverser stowage. The warning also described engine

[29] See Attachment 5 - Bombardier Learjet 60/60X Temporary Flight Manual Change dated March 2009

power lever movements and light indications on the cockpit panel and on the engine indication system panel that result from the damaged squat switch and stated the corrective action to take.

11.2 Training for Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment

Interviews conducted provided evidence of some training for an Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment. The training was not all inclusive. Training specifically on the Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment procedure was not required but was included under a broader training category of thrust reverser malfunctions. Specific malfunction events within the engine thrust reverser category were chosen by the simulator instructor for each training session and were not necessarily listed in the simulator training syllabus.

Interviews with Learjet 60 instructors at FSI and Learjet 60 flight crews indicated that the majority of thrust reverser malfunctions presented during flight training were that of an engine thrust reverser inadvertent deployment rather than an Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment. In addition, when the Inadvertent Stow of Thrust Reverser After A Crew-Commanded Deployment scenario was introduced in training, it was generally used by instructors during landing training scenarios and seldom used during takeoff or aborted takeoff scenarios.

15.0 FAA OVERSIGHT

The FAA Flight Standards District Office (FSDO) in Long Beach, California, was responsible for the every day oversight of Global Exec Aviation. The Principle Operations Inspector (POI) for Global Exec Aviation had been in that position since November 2007 and prior to that time he was the Assistant POI for Global Exec Aviation.

A review of FAA's National Program Tracking and Reporting Subsystem (NPTRS) revealed that during oversight of Global Exec Aviation in the 60 months prior to the accident, the FAA conducted the following records of activity:

- 17 inspections pertaining to Aviation Education and Safety Promotion.
- 44 inspections pertaining to Organizational Certification.
- 2 inspections pertaining to Aircraft and Equipment.
- 153 inspections pertaining to Airmen Certification oversight.
- 38 inspections pertaining to Surveillance.
- 5 inspections pertaining to Investigations.
- There were 16 inspection records that pertained to the accident captain and 1 record that pertained to the accident F/O. These were normal oversight inspections with no remarkable comments.

FSI in Tucson, Arizona had been approved for use by the Global Exec Aviation POI as a Lear 60 training facility. The FSI Learjet 60 training that was approved for Global Exec Aviation Learjet 60 pilots was the FAA approved Basic Bombardier Learjet 60 training program. Global Exec Aviation did not have airline specific training for the Learjet 60 and elected to use the same basic Learjet 60 program that FSI taught to other Learjet 60 operators. Interviews with the current (at the time of the accident) and former POIs of Global Exec Aviation indicated they did not observe

any training of Global Exec Aviation pilots that occurred at FSI. The current and former POIs of Global Exec Aviation indicated that they relied on the POI of FSI to be responsible for oversight of the training that occurred at FSI. The current and former POIs of Global Exec Aviation stated they did not conduct direct surveillance of Global Exec Aviation pilot training at FSI. The Global Exec Aviation POIs did state that that they reviewed oversight records of the FSI POI's surveillance of training and examined FSI's Global Exec Aviation pilots training folders. Post-accident interviews indicated there was no direct interaction or communication between the Global Exec Aviation POIs and the POI who had oversight of the FSI training center in Tucson, AZ. The Global Exec Aviation POIs also indicated that if there was a concern about the training, they would expect the FSI POI to inform them of the concerns.

The actual monitoring of training received at Flight Safety International in Tucson, AZ, was handled by the FAA Fleet Training Program Manager (FTPM), who reported directly to the FSI POI who was located in Wichita, KS. The FTPM was located at the FAA FSDO located in Scottsdale, AZ. An interview with the FTPM confirmed that there was no communication or interaction between him and the POI of Global Exec Aviation. He did not recall if he had observed any Global Exec pilots who went through training at FSI.

Submitted by:

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David Tew
Aviation Safety Investigator - Operations
June 4, 2009

TABLE OF ATTACHMENTS DCA08MA098

Attachment	Description
Attachment 1	Interview summaries
Attachment 2	Global Exec Aviation Crewmember Logbook Report
Attachment 3	Global Exec Aviation Ops Spec paragraph A096
Attachment 4	Bombardier Advisory Wire 32-045
Attachment 5	Bombardier Learjet 60/60X Temporary Flight Manual Change
Attachment 6	FAA Interpretation
Attachment 7	Taxi Route Diagram
Attachment 8	Global Exec Aviation Takeoff Profile
Attachment 9	Global Exec Aviation Aborted Takeoff Profiles